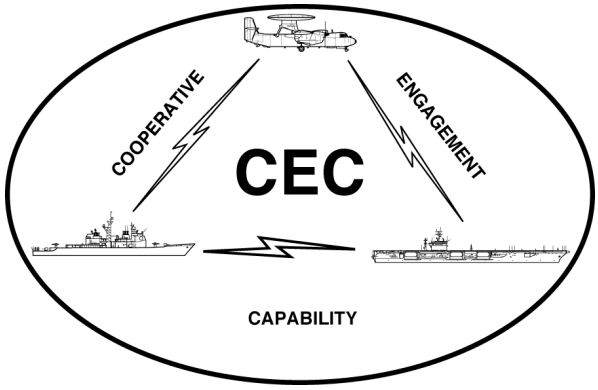
COOPERATIVE ENGAGEMENT CAPABILITY (CEC)



The Cooperative Engagement Capability (CEC) is a system of hardware and software that allows ships to share radar data on air targets. Radar data from individual ships of a Battle Group is transmitted to other ships in the group via a line-of-sight, data distribution system (DDS). Each ship uses identical data processing algorithms resident in its cooperative engagement processor (CEP), resulting in essentially the same display of track information on aircraft and missiles in each ship. An individual ship can launch an anti-air missile at a threat aircraft or anti-ship cruise missile (ASCM) within its engagement envelope, based on radar data relayed to it by another ship. Program plans include the addition of E-2C aircraft equipped with CEP and DDS, to bring airborne radar coverage plus extended relay capability to CEC. CEP-equipped units, connected via the DDS network, are known as Cooperating Units (CUs).

BACKGROUND INFORMATION

An at-sea demonstration of CEC was conducted during FY90. An early operational assessment was conducted in FY94, based on results of at-sea developmental testing, including missile firings at the Atlantic Fleet Weapons Training Facility in Puerto Rico. Although there were significant operational realism limitations, CEC was determined to be potentially operationally effective and potentially operationally suitable. Approval to begin EMD (Milestone II) was granted in May 1995. An additional early operational assessment (OT-1A) of the airborne component of the CEC network was conducted in September 1995. In accordance with congressional guidance, the Navy certified IOC for CEC (engineering development model equipment upgraded to AN/USG-1) in late FY96.

OT&E to support the initial LRIP decision of AN/USG-2 equipment was conducted in August 1997. Although CEC was assessed as being potentially operationally effective and potentially operationally suitable, significant problems were observed in Battle Group interoperability and in software reliability. Interoperability problems experienced in early 1998 at-sea testing with the latest Aegis Weapon System software involved CEC, as well as the Aegis Weapon System, ACDS Block 1, and the command and control processor for the tactical data links. This resulted in freezing the CEC software configuration (Baseline 2) and decelerating CEC development so that associated system software (Aegis Weapon System (AWS) Baseline 6.1 and Advanced Combat Direction System (ACDS) Block 1) could catch up.

The replanned program, challenged by the requirement to synchronize testing with fleet deployment schedules, included four at-sea test periods in 2000, followed by TECHEVAL and OPEVAL in 2001. The full production decision is expected during 1QFY02. CEC was designated as an ACAT ID program in FY99.

TEST & EVALUATION ACTIVITY

Analysis of results from DT-IIF/OT-IIA3, conducted in late September 2000 in the Virginia Capes (VACAPES) operating area, continued into October and November 2000. This was the first time that such a large number of CUs had been assembled for testing, and problems were discovered with network operations. From the analysis, software fixes were developed to mitigate the effects of the problems for the December 2000 testing.

As a precursor to the Technical Evaluation (TECHEVAL), a phase of DT was conducted in December 2000, both at the Atlantic Fleet Weapons Training Facility (AFWTF) in Puerto Rico and in the VACAPES operating area. Participants in the Puerto Rico phase included four Aegis cruisers (two with AWS Baseline 5.C and two with AWS Baseline 6.1), one CEC-equipped aircraft equipped with CEC, and a CEC node at Saint Thomas, VI. In the Virginia Capes area, participants were the four cruisers, the two land-based test sites (LBTS) at Wallops Island, VA and at Dam Neck, VA, two CEC-equipped aircraft, and two ACDS Block 1 ships, USS *John F. Kennedy* and USS *Wasp*. Extensive tracking runs were conducted against aircraft and target drones. EA was conducted against ship radars. Standard Missiles and Sea Sparrows were fired at target drones. Two non-CEC Aegis destroyers participated in the exercise. This testing was observed by DOT&E staff.

TECHEVAL was conducted during February and March 2001, again at AFWTF and in the VACAPES area. Testing followed the same pattern as for the precursor DT in December 2000 except that the ACDS Block 1 ships also participated during the phase at AFWTF.

OPEVAL was conducted in late April 2001 at AFWTF and in early May 2001 in the VACAPES area. As during the preceding DT, CEC-capable participants involved four Aegis cruisers (two with AWS Baseline 5.C and two with Baseline 6.1), two ACDS Block 1 ships (the aircraft carrier USS *John F. Kennedy* and the amphibious warfare ship USS *Wasp*), two aircraft (an E-2C and a P-3 configured to emulate an E-2C) and, in the VACAPES area only, two land-based test sites in Virginia (Surface Combat Systems Center at Wallops Island, configured as Aegis Baseline 6.1, and the LBTS at Dam Neck, configured as ACDS Block 1 with SPS-48E radar). For both phases, two non-CEC Aegis destroyers were participants. At both locations, a land-based DDS relay station provided another node in the CEC network.

OPEVAL included 23 days underway for the *Kennedy* Battle Group and the two Aegis Baseline 5.C cruisers. Thirteen days were on the firing ranges at AFWTF and VACAPES. Both actual and simulated missile firings were conducted against 42 targets that simulated high-altitude as well as sea-skimming enemy ASCMs. In some cases, actual ASCMs were used as targets.

Testing was conducted in accordance with a DOT&E-approved TEMP and test plan. The Director observed part of the VACAPES phase and his staff observed most of the testing at both locations.

TEST & EVALUATION ASSESSMENT

Based on results of the OPEVAL, the surface CEC AN/USG-2(V) equipment with CEC Baseline 2.0 software is operationally effective and operationally suitable. Situational awareness was improved and CEC ships were able to track and engage targets at greater ranges than without CEC. The extension of range at which detection and tracking occurred improved survivability of CEC ships by increasing the opportunity for additional missile salvoes. Notwithstanding these conclusions, results also indicate that the full benefit of CEC has not been realized by virtue of the immature Aegis Weapon System Baseline 6.1 and the limited Aegis Display System in the Aegis cruisers, as well as the defective ACDS Block 1 system installed in USS *Kennedy* and USS *Wasp*. (ACDS Block 1 was determined to be neither operationally effective nor operationally suitable during its February 1998 OPEVAL and during subsequent OT&E. Its successor system, the Ship Self Defense System Mark 2, is still in development.) The Battle Group Integration and Interoperability COI was resolved as unsatisfactory. The Joint Interoperability COI was partially resolved; further examination during FOT&E is required.

CEC exceeded its availability and reliability thresholds and, while it is considered maintainable, improvement in the built-in-test is needed. The Maintainability COI is partially resolved; correction of the noted deficiencies and retest during FOT&E are required. COIs of Logistic Supportability, Compatibility, Interoperability, Training, Human Factors, Safety, and Documentation were resolved as satisfactory, although training issues with the combat systems, vice CEC, degraded overall results.

LESSONS LEARNED

The PEO implemented an analytical and management structure to examine test data from the major subsystems: AWS, ACDS Block 1, CEC, and the tactical data link command and control processor. Through collaborative analysis between the major subsystem teams, rapid feedback was provided to a senior system engineering council that made recommendations to the PEO regarding software modifications to enhance overall system performance.

This system of systems using different ship classes and aircraft was replete with interoperability challenges, as well as the potential for significant progress toward realization of a single integrated air picture for Battle Group units. The interoperability challenges were the major obstacles, and while the Navy addressed them impressively, as evidenced by their significant commitment of ships, aircraft, land-based test sites, and other resources during the multiple at-sea periods of testing, there is still work to be done.

This PEO's overall approach could establish a pattern for emulation by other acquisition managers challenged with the development and delivery of complex, highly interactive systems of systems that cut across PMs, PEOs, Systems Commands, and other organizational boundaries.

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